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**H**alfway up a single 35-metre fixed rope in the jungles of Panama. I pause, gently spinning in my harness in the cloying heat, and look down. At once my left foot, held in a blue nylon sling, begins to jiggle involuntarily and both legs are soon hard at it. Just relax, I murmur to myself. Disco-legs. I've been warned, are a common enough sensation among inexperienced tree-climbers.

Craning his neck on the ground far below is Andrew Mitchell, the chief executive and founder of the Global Canopy Programme (GCP), an Oxford-based conservation body and a prime-mover in this project in Panama. Tanned and a little sunburnt from the morning's boat trip along the Panama Canal, Mitchell, 51, is a pioneering researcher in high-canopy exploration. When he first emerged on to the roof of the forest more than two decades ago, the canopy – the highest level of branches and foliage in a forest, formed by the crowns of the trees – was an almost completely unknown world. It's obvious why – it is fiendishly difficult getting up here.

Although ropes remain a versatile and inexpensive option, canopy scientists have had to develop a range of new methods for exploring tall trees: towers, aerial walkways, one-man balloons and even airships are now an option. But it is giant construction cranes, an innovation that revolutionised canopy exploration, that are the favoured mode. Helicoptered into the forest in pieces, they are then erected on a permanent base from where scientists can be taken aloft in the crane's basket in complete safety.

Panama was chosen as this project's location, primarily because there is a permanent canopy crane here but also because the Smithsonian Tropical Research Institute (STRI) – another key partner in the project – has a presence here. Using cranes was first thought of by the

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American scientist Dr Alan Smith. Sitting in a car park in Florida in 1990, he saw a crane working on the skyline and on his next trip to Panama rented one and erected it in the jungle.

'Sir Francis Drake was probably the first Englishman in the canopy in Panama,' Mitchell says with a laugh. 'Around 450 years ago, he was dragged up a "goodly and high tree by an Indian", from where he could see two oceans. He vowed to be the first Englishman to sail the



Pacific, and did so in the Golden Hind, where he attacked the Spanish.'

Discoveries that Mitchell and a handful of others made 20 years ago revealed how little we knew about life on earth. Now the number of species on the planet, once thought to be about a million, is as many as 50 million. But trying to fathom how much of it is in the canopy rather than the soil of tropical rainforests is now the compelling question for the 30 multi-disciplined

entomologists from 15 countries assembled at the project's base camp – STRI's permanent station on Barro Colorado Island. Once the scientists have finished their research they will be better placed to gauge how the forest interacts with the atmosphere and if climate change is, as most suspect, causing biodiversity loss.

From the canopy raft, directly above me, 39-year-old Thierry Aubert glances down, looking mildly bored. For six weeks, in 98 per cent

## Blowing in the wind

High in the treetops of Panama, scientists are hoping to find the answer to our rapidly changing climate and disappearing species, using cranes, helium balloons and rubber rafts.

Jonny Beardsall joined them in the canopy. Photographs by Laurent Pyot

**Left** the giant canopy raft is placed by helicopter in the tops of the trees. **Top** an entomologist, Hector Barrios, collects insects from the raft edges. **Above** Thierry Aubert, a professional climber, installs light traps to collect insects around the raft

humidity, he and two other professional climbers have been working in the crowns of these trees, exploring in close-up one of the world's richest, most threatened and least known habitats. This is where more than 90 per cent of living material in a forest exists.

Climbing a fixed rope is, in fact, as simple as it is exhausting. At the base of the tree, I strapped on a sit-harness, which fits tight around the waist and thighs, and another around the chest, which connects to two metal ascenders fixed to the rope. These devices – one attached to your upper body and another to a foot sling – act like ratchets. Five minutes later, I wriggle through the raft's entry hole into the relative safety of the giant, pretzel-shaped ring of inflated rubber tubing that is anchored on top of the canopy trees with ropes. Underneath the tubing, a net, which trampolines alarmingly and sways in the breeze, forms a high-level observatory, from where researchers scuttle about, Gollum-like, collecting samples from traps set in the foliage at the edges of the net.

'A branch recently gave way so it has not been safe to work up here,' says Aubert, gesturing to where a section of the raft slopes steeply and finishes, dangling 35 metres from the ground. He makes a cursory inspection of the anchor points, which attach the raft to several branches.



**Above** Andrew Mitchell, founder of the Global Canopy Programme. **Right** Hector Barrios performs a night-time collection of trapped insects, using a helium balloon

It is getting late and we are beginning to lose the light. Above the hum of countless insects, I can hear the cicadas start up as I abseil back down to join Andrew Mitchell on the jungle floor. 'The rainforest,' he says, 'feels like my second home.' And in a faded, short-sleeve khaki shirt, cargo pants and trainers, he moves through it like a local: light on his feet, following the slippery unmarked paths, barely pausing to flick from his arm an unforgivably large ant with lethal-looking pincers. He halts unexpectedly to explain a particular tree or to point excitedly at a monkey – a Geoffroy's tamarin – moving in the foliage above us, or to listen to the unmistakable whoops of howler monkeys. Then he suddenly drops to one knee to show me a procession of leaf-cutting ants each carrying a tiny piece of leaf, which they will



take to their communal jungle storeroom. 'They don't actually eat the leaves, they eat the fungus that will grow on them,' he whispers. 'On one trip, we couldn't work out what was happening to the labels on our traps. It was the ants; we found the labels discarded, in little pieces, by a nest.'

Mitchell is an easy communicator. 'Only a few people are doing canopy studies and they are particularly bad at talking to each other. So I'm helping to bring together the right people.'

He first arrived in Panama in 1976, when as a member of Lt Col John Blashford-Snell's epic endeavour, Operation Drake, he helped build one of the world's first canopy walkways in the jungles of Darien. 'A team of Royal Engineers erected a walkway, and to get up there you climbed a rope ladder,' he says, shoving a grubby hand through his short greying hair. 'I was so eager, I managed to break the first two rungs and only realised I hadn't clipped on my safety line when I was more than halfway up. When I got to the top, I froze, I hadn't expected everything to be swaying – and trees really do – but I was stunned by what I saw.'

A year later, he joined the Royal Geographical Society's Mount Mulu Expedition to Sarawak, Borneo, to study primates. 'It was there, with a constant crick in my neck, looking for little black silhouettes that were gibbons, that I thought aha, why don't I get up there again?' Using a cross-bow to fire his lines into the high forks of trees – which is how it is still done – he built more walkways. 'I thought I'd be able to get close to the gibbons. However, once I was up there it didn't work, because they would just clear off or they'd pee on me.' But Mitchell was hooked. 'Canopy studies looked the perfect blend of science and adventure, which is why I still find them so appealing,' he continues, his well-spoken delivery fuelled with boyish enthusiasm.

In 1978, he became scientific coordinator of the Operation Drake, now known as Raleigh International, and helped organise scientific projects all over the world. In 1989 he co-founded Earthwatch Institute in the UK, and a decade later, as vice-president of the company's international headquarters in Boston, helped to turn it into one of the world's largest non-governmental funders of field research.

Working with a group of the world's leading forest canopy experts, Mitchell hatched plans for an international research initiative to co-ordinate and expand exploration of this still bewildering environment. The result was the GCP. Established in 2001, it is now a global network of universities and research centres investigating biodiversity and climate change.

Further along the path, we meet Alexey Tishechkin, a scientist from Belarus, and a bracket-beetle expert. With unstinting devotion, he beats a lush sapling with a stick and catches whatever drops off in a white cotton insect 'beating' tray; his finds will be sorted and labelled in the field laboratory, transferred to specimen jars and sent off for analysis. Every scientist, whether at tree-top height or on the forest floor, spends their waking hours collecting, identifying, curating and databasing specimens. Some set sticky traps – in effect, giant flypapers – close to the ground, while others use a fogging gun – a hand-held device with an incapacitating mist.

As expedition base camps go, this one on Barro Colorado Island, which was created when



From top researchers check insects that have fallen into collection bags while trying to escape the strong lights above; a three-toed sloth; a researcher fogs insects to make them fall on collection sheets below

'I thought I'd be able to get close to the gibbons. However, once I was up there, they either cleared off or peed on me'



the canal was built, is positively luxurious, and with its wooden cabins built into the jungle hillside is more akin to an eco-resort hotel. Each morning the entomologists – nearly all of whom are male – eat the chef's fried breakfast before taking a 20-minute boat ride followed by a bumpy 30-minute drive in a Land Cruiser to the forward camp in the San Lorenzo Protected Area, a lush splurge of lowland tropical jungle on the Caribbean coast.

The projects' architects, Yves Basset, who works for STRI, and Bruno Corbara, science director of the French-based Canopy Raft Consortium, are in the final week of this six-week, \$250,000 endeavour hosted by STRI and mainly funded by Solvay, the company which makes the rubber used in the canopy raft.

This is the first time that a crane, a one-man helium balloon known as the Treetop Bubble and an Icos – a clear-plastic, icosahedron (20-sided) unit that is permanently fixed in the fork of a tree, enabling scientists to live in it for days at a time – have been used in a large-scale study. But while the crane, balloon and Icos have proved their worth, frustratingly, the raft has been stymied because the helicopter never returned to lift it to other sites. 'The pilot wasn't keen,' was one assessment. In his defence, it was very demanding flying, because the suspended load, caught in the downdraft from the rotors, was liable to spin as it was lowered into position in the treetops.

The canopy is, scientists believe, fragmenting faster than any other habitat, and in 2010, the Convention on Biological Diversity will report on how countries are intending to cut biodiversity loss. 'It's a frightening target it has set itself,' Mitchell says. 'It is difficult to say how much we are losing if we don't know how much we've got in the first place. We need to know how much carbon dioxide is being absorbed by forests. This is crucial because rising CO<sub>2</sub> levels are causing the atmosphere to change, which will change the way that forests, and not just tropical ones, work.'

The GCP has a project in north-east Australia, examining the effects of increased carbon dioxide levels and rising earth temperatures on the region's wildlife. 'It gets a little scary,' he admits. 'Sixty per cent of Australia's biodiversity is in Queensland and much of it is only found there in

mountain forests. In 50 to 70 years' time, it is predicted that many of these species will have disappeared. Rising temperatures will have forced them to retreat to higher altitudes until they run out of territory.' The natural processes which keep temperatures stable, whereby trees and oceans absorb carbon dioxide from the air, are under threat. 'If we keep losing the trees, this is one mechanism less for absorbing these harmful greenhouse gases,' he says. 'Of course, no one is certain of any of this, which is why canopy studies are so important.'

Canopy studies is a hot topic. In 2012, the Kyoto Protocol on climate change is to be renegotiated. When it was first tabled, there were incentives to plant and protect new-growth forests but old-growth forests were excluded. So it's hardly surprising that countries such as Brazil and Malaysia, who receive no such benefits for retaining their remaining primary forests, are still felling. Ironically, burning the old forest floors once trees have been felled releases more carbon dioxide into the atmosphere than any new planting resolves.

In another part of the jungle, I walk to the base of the 42-metre-high crane and wait as a metal bas-

'We'll have a canopy observatory in Britain. We have an affinity with trees here'

ket, known as a gondola, is lowered to the ground. I squeeze in beside Laura Fagan, a Canadian, and Raphael Didham, a New Zealander, both dipterists (fly experts) and hold tight as the gondola rises directly until it hangs just under the 52-metre jib. From here it can be lowered silently into the crowns of trees. 'Cranes are new for us,' Fagan says, pausing to relay instructions by radio to the operator in the cab. 'Ours is a flight intercept trapping programme, which means we catch flies in traps set at different heights, and collect them in jars.'

'It's incredible,' says Didham. 'It's like discovering whales and dolphins for the first time,' he beams. 'We hope that it will tell us how many species are specialised for life in the canopy. Once we know that, we can extrapolate as to the distribution of life in the tropics.' For my own part, I am more absorbed by the three-toed sloth that is asleep on a bough directly below us. It is a male, curled up in a ball; its pale coat has a green tinge to it, which is due to algae that lives in the fur. Suddenly – which, for a sloth, is very, very slowly – it stirs and begins

to look round (this takes about five minutes) until it is staring at us, bemused, from a metre away.

In the laboratory on Barra Colorado Island, the British scientist Professor Roger Kitching, professor of ecology at Griffith University in Brisbane, squints into a dish containing tiny emerald-green moths. Kitching and about half a dozen other entomologists are hunched over their desks, sorting, describing, mounting and labelling ants, beetles, spiders, moths and flies. What they are all looking for is hard information that will help governments decide if they should or should not log a forest, even if it is done selectively. 'It's too early to say, but my gut feeling on the moths is that there are fundamental differences between what is found on the ground and what is in the canopy. This implies that if you want to conserve a forest, and what is living in it, you must conserve all of it, including the high canopy.'

According to Mitchell, taxonomists (classification experts) are themselves an endangered species, as not many graduates feel inclined to venture into the canopy identifying insects for scant fiscal rewards when there are more lucrative careers in the bio-tech industry. He and the GCP are now looking for funding to launch 20:20 Vision, its campaign for a network of 20 canopy crane observatories around the world by 2020; so far 10 are in place; Germany has three, Switzerland has one. (none yet in Britain, although one has been proposed); the others are in Australia, Japan, Malaysia, the USA, Venezuela and Panama.

If Mitchell's 20:20 Vision becomes a reality (and he is hell-bent that it will) will we see a canopy observatory somewhere in Britain? 'Of course we'll have one. We have an affinity with trees – why else do we build so many tree houses for our children to climb about in? The thing is, we know so little about the canopies of our forests and woodlands, we must open an observatory somewhere. Who knows where? It might be in Scotland, it could be in the south. Diseases like Dutch Elm and Sudden Oak Death Syndrome may be symptoms of an imbalance in nature, which could be due to climate change. We need to know.' With three permanent canopy cranes in Germany and another in Switzerland, he thinks it is high time Britain joined the party.

To see canopy scientists in action, visit the Canopy Season at the Eden Project in Cornwall (01726-811911) before the end of October. For information on the Global Canopy Programme visit [www.globalcanopy.org](http://www.globalcanopy.org)



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